
Appendix D

Estimates of Mercury, PCB, Dioxins, and HCB Releases in the U.S. Lake Superior Basin

Summary Tables

Introduction

The information contained in this summary of estimated releases from the U.S. Lake Superior basin is based upon a consultant's report to the U.S. Environmental Protection Agency (USEPA) titled:

Estimates of Mercury, PCBs, Dioxins, and HCB Releases in the U.S. Lake Superior Basin, prepared by Tetra Tech, Inc., under contract with U.S. Environmental Protection Agency, September, 1996.

Copies of the report are available from:

Lake Superior Regional Team Manager
USEPA - Region 5
T-13J
77 West Jackson Blvd.
Chicago, IL 60604-3590

Enclosed with this appendix are summary tables for U.S. sources. These tables were used in the construction of tables and figures in Chapter 3 of the Stage 2 LaMP.

Table D-1. Summary of Estimated Mercury Release in the U.S. Lake Superior Basin, 1990.

Source/Use Category	Emissions (kg/yr)			Use, Disposal, Soils (kg/yr)
	Water	Air	Total Releases	
INDUSTRIAL				
General industrial activity	0.04	8.9	8.94	-
Petroleum refining	0.006	1.85	1.86	-
<i>INDUSTRIAL TOTAL</i>	0.05	10.8	10.8	-
MINING				
Copper mining	-	550 ^a	550	-
Iron mining	-	362 ^b	362	-
<i>MINING TOTAL</i>	-	912	912	-
FUEL COMBUSTION				
Oil	-	22.6	22.6	-
Natural gas	-	24.8	24.8	-
Wood	-	1.0 ^c	1.0	-
Coal	-	88.5 ^d	88.5	-
<i>FUEL COMBUSTION TOTAL</i>	-	136.9	136.9	-
INCINERATION				
WLSSD	-	11.2	11.2	-
Small incinerators	-	48.0	48.0	-
Other sludge	-	1.0	1.0	-
Medical waste	-	22.7	22.7	-
Cremation	-	2.5	2.5	-
<i>INCINERATION TOTAL</i>	-	85.4	85.4	-
COMMERCIAL PRODUCTS				
Dry cell batteries	-	-	-	851
Electric lighting	-	14.6	14.6	37.9
Fever thermometers	-	-	-	22.9
Thermostats	-	-	-	15.9
Light switches	-	-	-	0.57
Pigments	-	-	-	14.1
Paint	-	131.9	131.9	25.6
Fungicides	-	3.8	3.8	-
<i>COMMERCIAL PRODUCTS TOTAL</i>	-	150.3	150.3	968
COMMERCIAL/MUNICIPAL ACTIVITIES				
WLSSD	21.5	-	21.5	-
Landfills	-	38.8	38.8	-
Dental uses, hospitals, and labs	0.08	0.48	0.56	6.2
Residential, Other	0.32	-	0.32	-
<i>COMMERCIAL/MUNICIPAL TOTAL</i>	21.9	39.3	61.2	6.2
ANTHROPOGENIC TOTAL	21.95	1,334.7	1,356.6	974.2
NATURAL	-	216	216	-
TOTAL	22	1,551	1,573	974

^a The value for copper mining is from the Copper Range smelter, which closed in September 1995.

^b Minnesota taconite processing facilities were estimated to have released 362 kg per year of mercury in 1990. While that amount has been included in this total, some of this mercury may be captured by emission control equipment and discharged to tailings basins. The Minnesota taconite estimate was not available for the Tetra Tech, 1996 report.

^c Fuel Combustion – Wood: Tetra Tech (1996) reports 27.1 kg per year of mercury from this source. New information based on Pang (1997) was used to extrapolate from Minnesota statewide estimates to the Lake Superior U.S. basin population, resulting in an estimate of 1.0 kg per year of mercury.

^d Clarification on Fuel Combustion – Coal: This estimate for 1990 was based on a population extrapolation as explained in Tetra Tech (1996). Work is underway to refine the estimates based on emissions from facilities in the basin.

Table D-2a. Summary of Estimated PCB Use Data for Utilities and Industries in the U.S. Lake Superior Basin (Data from 1991-1994).

Source/Use Category	In Use (kg)
Large Utilities	
Capacitors	10,594 ^a
Transformers	38.6 ^a
Small utilities	15,985 ^b
Industries	637,346 ^c
TOTAL	663,964

^a Data from the 1994 schedule for Minnesota Power.

^b Data based on Michigan small utilities information of 34,766 kg PCB/148,108 persons served – 68,100 persons estimated serviced in U.S. Lake Superior basin by small utilities

^c Data based on Michigan industries information of 213,582 kg PCB/142,606 population of Michigan – 425,548 persons on U.S. Lake Superior basin.

By far the most complete information on PCB use in the U.S. Lake Superior basin addresses the large utilities in the adjacent states. The Great Lakes Utility (GLU) Report, in which this information is summarized, was prepared for USEPA Region 5 by the utilities industry in response to USEPA's voluntary PCB phasedown program. Three of the major electric utilities including Minnesota Power, Northern States Power, and Wisconsin Electric Power, serve territory in the U.S. Lake Superior basin.

Small utilities and rural electric cooperatives are not represented by the GLU. Small utilities might still be using PCB capacitors since they possibly have fewer resources to invest in phasedown programs. A state-wide search of the 1991 (last year for which complete information is available) Michigan Critical Materials Register annual wastewater report data base identified some small electric utilities using PCBs. Based on the number of customers, PCB use by small utilities in Michigan can be extrapolated to the Lake Superior basin.

Information to estimate the use of PCBs by industries came from the Michigan Critical Materials Register annual wastewater report for 1991 (Christopher Hull, MIDNR, personal communication, 6/12/95). Based on a population extrapolation from Michigan (pop. = 142,606; Allardice and Thorp, 1994), to the rest of the U.S. Lake Superior basin (pop. = 425,548), it is estimated that there are 637,346 kg PCBs in use by industries in the U.S. Lake Superior basin.

Total PCBs Releases

A total of 30.6 kg/yr of PCBs were estimated to be released and 663,964 kg PCB were estimated to be in use in the U.S. Lake Superior basin in 1990 (Table D-2b).

Table D-2b. Summary of Estimated PCB Releases to the U.S. Lake Superior Basin.

Source/Use Category	Use (kg/yr)	Emissions (kg/yr)
LARGE UTILITIES		
Capacitors	10,594	N.A. ^a
Transformers	38.6	N.A.
SMALL UTILITIES	15,985	N.A.
INDUSTRIES	637,346	N.A.
SPILLS		
Land	-	8.0
Air	-	0.02
Water	-	22.6
TOTAL	663,964	30.6

^a N.A. = Not applicable. It is assumed that the capacitors and transformers in use are contained in closed environments, and will not release unless a spill occurs.

**Table D-3. Summary of Estimated Dioxin Loadings in the U.S. Lake Superior Basin
Based on 1990 Data.^a**

Source/Use Category	Emissions (g TEQ/year)			Use, Disposal, Soils (g TEQ/yr)
	Water	Air	Total Releases	
INDUSTRIAL				
Forest products	0 - 0.6	-	0 - 0.6	-
Petroleum refining	1.5×10^{-5}	-	1.5×10^{-5}	-
Wood preserving	-	-	-	$2.9 \times 10^{-3} \text{ g}^b$
Mining	-	0.1	0.1	-
<i>INDUSTRIAL TOTAL</i>	$1.5 \times 10^{-5} - 0.6$	0.1	$1.5 \times 10^{-5} - 0.7$	$2.9 \times 10^{-3} \text{ g}$
FUEL COMBUSTION				
Coal	-	0.73	0.73	-
Wood	-	2.7	2.7	-
<i>FUEL COMBUSTION TOTAL</i>	-	3.43	3.43	-
INCINERATION ^c				
Burn barrels ^d				
Medical and industrial	-	134	134	-
Small incinerators ^e	-	235-2,274	235-2,274	-
WLSSD	-	0.19	0.19	-
<i>INCINERATION TOTAL</i>	-	369-2,408	369-2,408	-
MUNICIPAL/RESIDENTIAL				
Wastewater treatment plant sludge	-	-	-	0.014
<i>MUNICIPAL/RESIDENTIAL TOTAL</i>	-	-	-	0.014
COMMERCIAL PRODUCTS				
Pentachlorophenol use		-		18.0
Polychlorinated biphenyl spills ^f	-	-		0.006
<i>COMMERCIAL PRODUCTS TOTAL</i>	-	-		18.0
TOTAL	0.8	373-2,412	373-2,412	18

^a Many of these sources have changed processes or improved pollution controls to reduce or eliminate dioxins since 1990.

^b Estimated g TEQ present at site of wood preserving plant based on pentachlorophenol sampling in soils. This does not represent an annual release to the environment. This value probably underestimates potential dioxin present at the site based on the years of operation. Actual sampling for dioxins is planned as part of the corrective action for the site.

^c Estimates were based on extrapolation from other studies.

^d Burn barrels are believed to generate a significant amount of dioxin. At this time, no estimate for dioxin TEQ is available for the Lake Superior Basin. However, in 1997, burn barrels in the three Minnesota counties bordering Lake Superior were estimated to have produced 1,161 g total PCDD (polychlorinated di-benzo dioxin). Statewide, Minnesota burn barrels probably produced from 8,000 to 90,000 times the amount of dioxin as municipal solid waste incinerators.

^e Estimated releases had a wide range. The lower value is used in figures for Chapter 3.

^f Dioxin from use of PCBs was not included in total because it does not represent an annual release to the environment.

Table D-4. Summary of Estimated HCB Releases in the U.S. Lake Superior Basin.

Source/Use Category	Emissions and Discharges (kg/yr)			Use, Disposal, Soils (kg/yr)
	Water	Air	Total Releases	
INDUSTRIAL				
Forest products	-	-	-	-
Other products	-	-	-	-
Mining	-	1.9 ^a	1.9	-
Wood preserving	-	-	-	-
<i>INDUSTRIAL TOTAL</i>	-	1.9	1.9	
INCINERATION				
Class III, medical waste	-	0.13	0.13	-
Class IV, small incinerators	-	-	-	-
WLSSD	-	1.9	1.9	-
<i>INCINERATION TOTAL</i>	-	2.0	2.0	-
FUEL COMBUSTION				
Coal	-	8.1×10^{-3}	8.1×10^{-3}	-
Wood	-	7.4×10^{-3}	7.4×10^{-3}	-
Diesel Fuel	-	2.3×10^{-3}	2.3×10^{-3}	-
Leaded gasoline	-	9.6×10^{-5}	9.6×10^{-5}	-
Unleaded gasoline	-	4.8×10^{-5}	4.8×10^{-5}	-
<i>FUEL COMBUSTION TOTAL</i>	-	1.8×10^{-2}	1.8×10^{-2}	-
MUNICIPAL/RESIDENTIAL				
Landfills	-	-	-	-
Wastewater treatment plants	-	-	-	-
Dry cleaners ^b	-	-	-	0.21
<i>MUNICIPAL/RESIDENTIAL TOTAL</i>	-	-	-	0.21
COMMERCIAL PRODUCTS				
Pentachlorophenol use	-	-	-	0.7 DC ^c
Chlorinated solvent use	-	-	-	-
Pesticide use	-	-	-	0.07
<i>COMMERCIAL PRODUCTS TOTAL</i>	-	-	-	0.07
TOTAL	-	3.52	3.92	0.3

^a Copper Range smelter closed in September 1995.

^b The estimate for air emission of HCB from dry cleaners, which appeared in the draft Stage 2 LaMP and in Tetra Tech (1996), has been removed. This was based upon comments received and further evaluation of the literature (see discussion in the Responsiveness Summary).

^c DC = double count and was not included in the total.

References

Allardice, D.R. and S. Thorp. 1994. *A Changing Great Lakes Economy: Economic and Environmental Linkages*. Proceedings of the State of the Lakes Ecosystem Conference, October 26-28, 1994, Dearborn, MI.

Hull, Christopher. Personal communication. 12 June 1995. Michigan Department of Natural Resources, Lansing, MI.

Pang, Sux Man. November 1997. Mercury in Wood and Wood Fuels. A thesis submitted to the faculty of the graduate school of the University of Minnesota. In partial fulfillment of the requirements for the degree of Master of Science in Civil Engineering. Minneapolis, MN.